

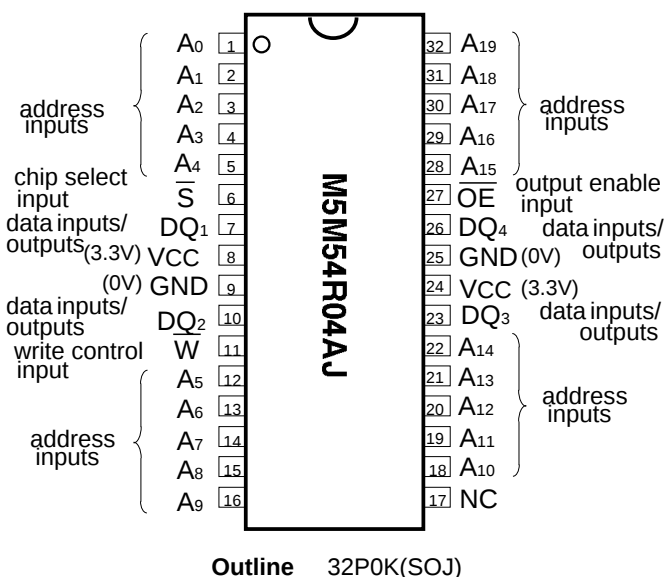
DESCRIPTION

The M5M54R04AJ is a family of 1048576-word by 4-bit static RAMs, fabricated with the high performance CMOS silicon gate process and designed for high speed application.

These devices operate on a single 3.3V supply, and are directly TTL compatible. They include a power down feature as well.

FEATURES

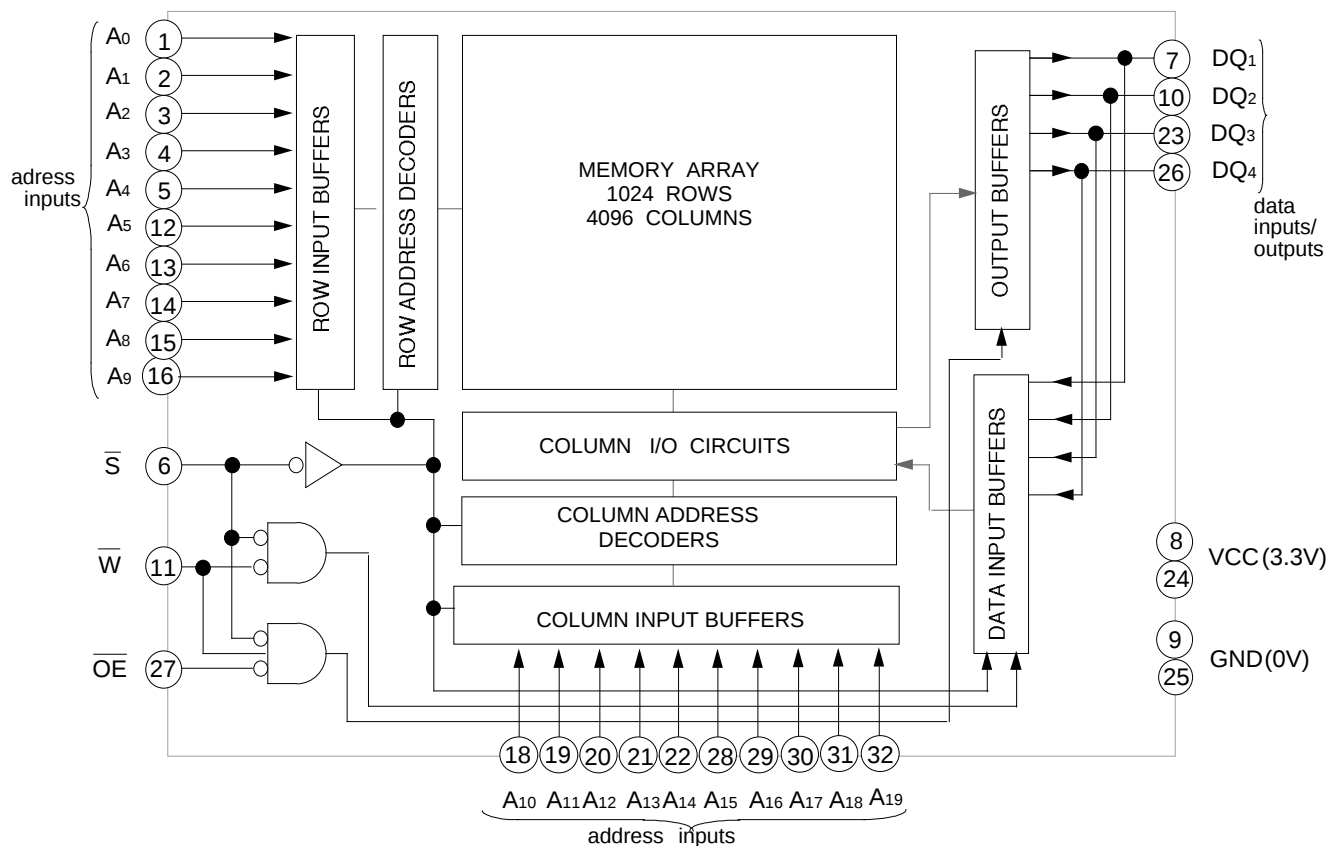
- Fast access time M5M54R04AJ-10 ... 10ns(max)
M5M54R04AJ-12 ... 12ns(max)
M5M54R04AJ-15 ... 15ns(max)
- Single +3.3V power supply
- Fully static operation : No clocks, No refresh
- Common data I/O
- Easy memory expansion by S
- Three-state outputs : OR-tie capability
- OE prevents data contention in the I/O bus
- Directly TTL compatible : All inputs and outputs

PIN CONFIGURATION (TOP VIEW)**APPLICATION**

High-speed memory units

PACKAGE

M5M54R04AJ : 32pin 400mil SOJ

BLOCK DIAGRAM

FUNCTION

The operation mode of the M5M54R04AJ is determined by a combination of the device control inputs $\overline{S}$, $\overline{W}$ and $\overline{OE}$. Each mode is summarized in the function table.

A write cycle is executed whenever the low level $\overline{W}$ overlaps with the low level $\overline{S}$. The address must be set-up before the write cycle and must be stable during the entire cycle.

The data is latched into a cell on the trailing edge of $\overline{W}$ or $\overline{S}$, whichever occurs first, requiring the set-up and hold time relative to these edge to be maintained. The output enable input $\overline{OE}$ directly controls the output stage. Setting the $\overline{OE}$ at a high level, the output stage is in a high impedance state, and the data bus

contention problem in the write cycle is eliminated.

A read cycle is executed by setting $\overline{W}$ at a high level and $\overline{OE}$ at a low level while $\overline{S}$ are in an active state ($\overline{S}=L$).

When setting $\overline{S}$ at high level, the chip is in a non-selectable mode in which both reading and writing are disabled. In this mode, the output stage is in a high-impedance state, allowing OR-tie with other chips and memory expansion by $\overline{S}$.

Signal $\overline{S}$ controls the power-down feature. When $\overline{S}$ goes high, power dissipation is reduced extremely. The access time from $\overline{S}$ is equivalent to the address access time.

FUNCTION TABLE

$\overline{S}$	$\overline{W}$	$\overline{OE}$	Mode	DQ	Icc
H	X	X	Non selection	High-impedance	Stand by
L	L	X	Write	Din	Active
L	H	L	Read	Dout	Active
L	H	H		High-impedance	Active

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
V _{cc}	Supply voltage	With respect to GND	- 2.0* ~ 4.6	V
V _I	Input voltage		- 2.0* ~ V _{CC} +0.5	V
V _O	Output voltage		- 2.0* ~ V _{CC}	V
P _d	Power dissipation	T _a =25°C	1000	mW
T _{opr}	Operating temperature		0 ~ 70	°C
T _{stg(bias)}	Storage temperature(bias)		- 10 ~ 85	°C
T _{stg}	Storage temperature		- 65 ~ 150	°C

* Pulse width ≤ 3ns, In case of DC: - 0.5V

DC ELECTRICAL CHARACTERISTICS (T_a=0 ~ 70°C, V_{cc}=3.3V^{+10%}_{-5%}, unless otherwise noted)

Symbol	Parameter	Condition	Limits			Unit
			Min	Typ	Max	
V _{IH}	High-level input voltage		2.0		V _{cc} +0.3	V
V _{IL}	Low-level input voltage				0.8	V
V _{OH}	High-level output voltage	I _{OH} = - 4mA	2.4			V
V _{OL}	Low-level output voltage	I _{OL} = 8mA			0.4	V
I _I	Input current	V _I = 0 ~ V _{cc}			2	uA
I _{OZ}	Output current in off-state	V _I ($\overline{S}$)=V _{IH} V _{I/O} = 0 ~ V _{cc}			2	uA
I _{CC1}	Active supply current (TTL level)	V _I ($\overline{S}$)=V _{IL} other inputs=V _{IH} or V _{IL} Output-open(duty 100%)	AC	10ns cycle	190	mA
				12ns cycle	180	
				15ns cycle	160	
			DC		90	
I _{CC2}	Stand by current (TTL level)	V _I ($\overline{S}$)=V _{IH}	AC	10ns cycle	90	mA
				12ns cycle	70	
				15ns cycle	60	
			DC		40	
I _{CC3}	Stand by current	V _I ($\overline{S}$)=V _{cc} ≥0.2V other inputs V _I ≤0.2V or V _I ≥V _{cc} - 0.2V			10	mA

Note 1: Direction for current flowing into an IC is positive (no mark).

CAPACITANCE ($T_a=0\sim 70^{\circ}\text{C}$, $V_{cc}=3.3\text{V}^{+10\%}_{-5\%}$, unless otherwise noted)

Symbol	Parameter	Test Condition	Limit			Unit
			Min	Typ	Max	
C_i	Input capacitance	$V_I = \text{GND}, V_I = 25\text{mVrms}, f=1\text{MHz}$			7	pF
C_o	Output capacitance	$V_O = \text{GND}, V_O = 25\text{mVrms}, f=1\text{MHz}$			8	pF

Note 2: C_i, C_o are periodically sampled and are not 100% tested.

AC ELECTRICAL CHARACTERISTICS ($T_a=0\sim 70^{\circ}\text{C}$, $V_{cc}=3.3\text{V}^{+10\%}_{-5\%}$, unless otherwise noted)

(1) MEASUREMENT CONDITION

Input pulse levels $V_{IH}=3.0\text{V}, V_{IL}=0.0\text{V}$
 Input rise and fall time 3ns
 Input timing reference levels $V_{IH}=1.5\text{V}, V_{IL}=1.5\text{V}$
 Output timing reference levels $V_{OH}=1.5\text{V}, V_{OL}=1.5\text{V}$
 Output loads Fig.1, Fig.2

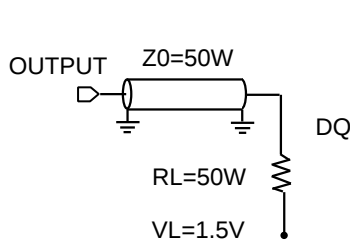


Fig.1 Output load

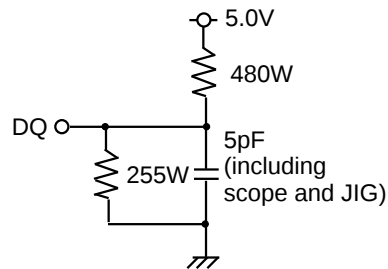


Fig.2 Output load for t_{en}, t_{dis}

MITSUBISHI LSIs
M5M54R04AJ-10,-12,-15

4194304-BIT (1048576-WORD BY 4-BIT) CMOS STATIC RAM

(2)READ CYCLE

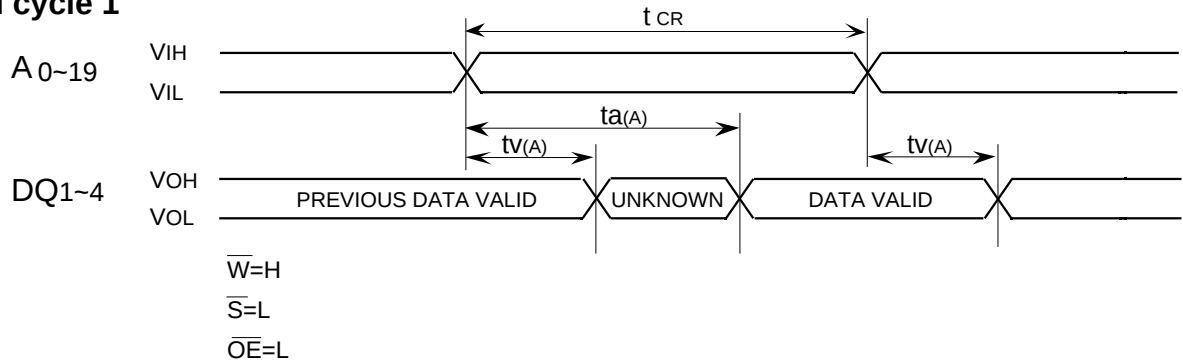
Symbol	Parameter	Limits						Unit
		M5M54R04AJ-10		M5M54R04AJ-12		M5M54R04AJ-15		
		Min	Max	Min	Max	Min	Max	
t _{CR}	Read cycle time	10		12		15		ns
t _{a(A)}	Address access time		10		12		15	ns
t _{a(S)}	Chip select access time		10		12		15	ns
t _{a(OE)}	Output enable access time		5		6		7	ns
t _{dis(S)}	Output disable time after $\overline{S}$ high	0	5	0	6	0	7	ns
t _{dis(OE)}	Output disable time after $\overline{OE}$ high	0	5	0	6	0	7	ns
t _{en(S)}	Output enable time after $\overline{S}$ low	2		3		3		ns
t _{en(OE)}	Output enable time after $\overline{OE}$ low	0		1		1		ns
t _{v(A)}	Data valid time after address change	2		3		3		ns
t _{PU}	Power-up time after chip selection	0		0		0		ns
t _{PD}	Power-down time after chip selection		10		12		15	ns

(3)WRITE CYCLE

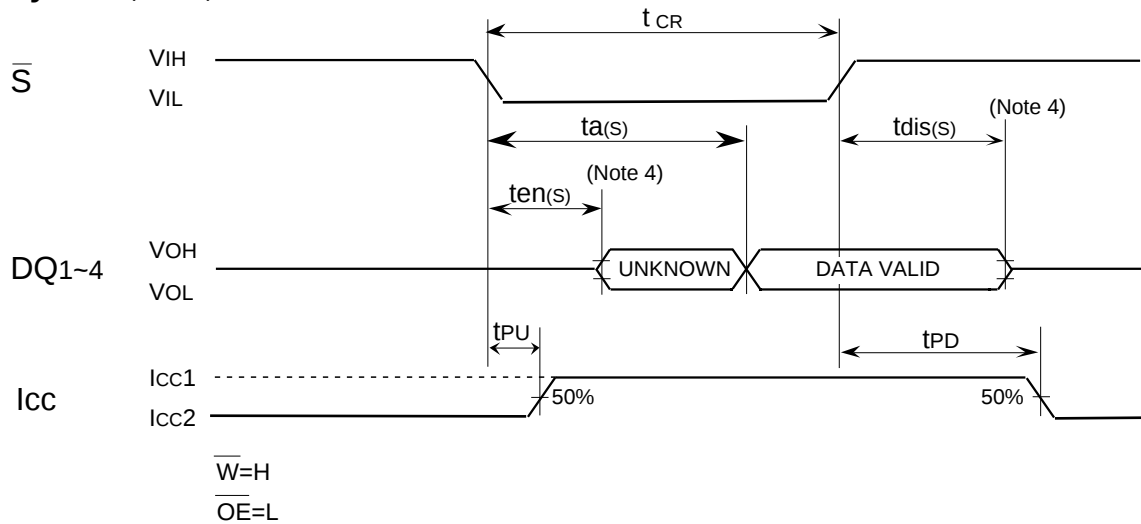
Symbol	Parameter	Limits						Unit
		M5M54R04AJ-10		M5M54R04AJ-12		M5M54R04AJ-15		
		Min	Max	Min	Max	Min	Max	
t _{CW}	Write cycle time	10		12		15		ns
t _{w(W)}	Write pulse width ($\overline{OE}$ low)	10		12		15		ns
t _{w(W)}	Write pulse width($\overline{OE}$ high)	8		10		10		ns
t _{su(A)1}	Address setup time($\overline{W}$)	0		0		0		ns
t _{su(A)2}	Address setup time($\overline{S}$)	0		0		0		ns
t _{su(S)}	Chip select setup time	8		10		10		ns
t _{su(D)}	Data setup time	5		6		7		ns
t _{h(D)}	Data hold time	0		0		0		ns
t _{rec(W)}	Write recovery time	1		1		1		ns
t _{dis(W)}	Output disable time after $\overline{W}$ low	0	5	0	6	0	7	ns
t _{dis(OE)}	Output disable time after $\overline{OE}$ high	0	5	0	6	0	7	ns
t _{en(W)}	Output enable time after $\overline{W}$ high	0		0		0		ns
t _{en(OE)}	Output enable time after $\overline{OE}$ low	0		0		0		ns
t _{su(A-$\overline{W}$H)}	Address to $\overline{W}$ High	8		10		10		ns

(4)TIMING DIAGRAMS

Read cycle 1



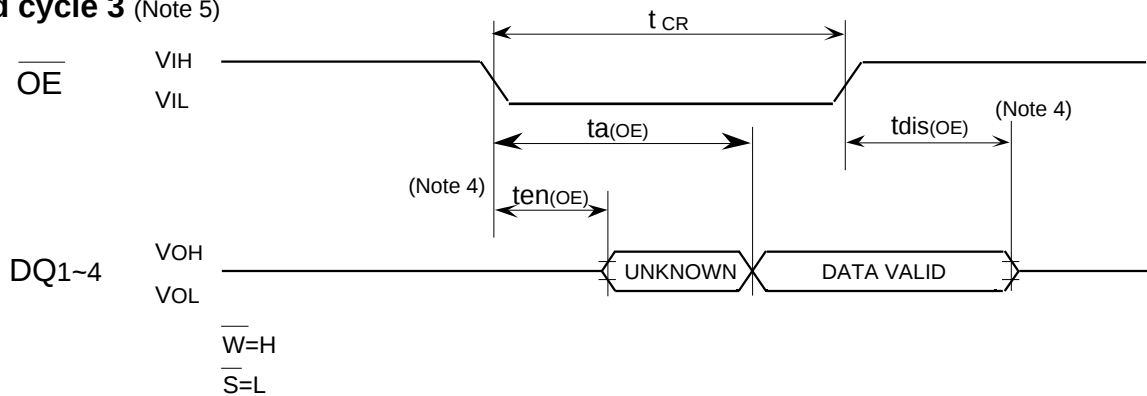
Read cycle 2 (Note 3)



Note 3. Addresses valid prior to or coincident with $\overline{S}$ transition low.

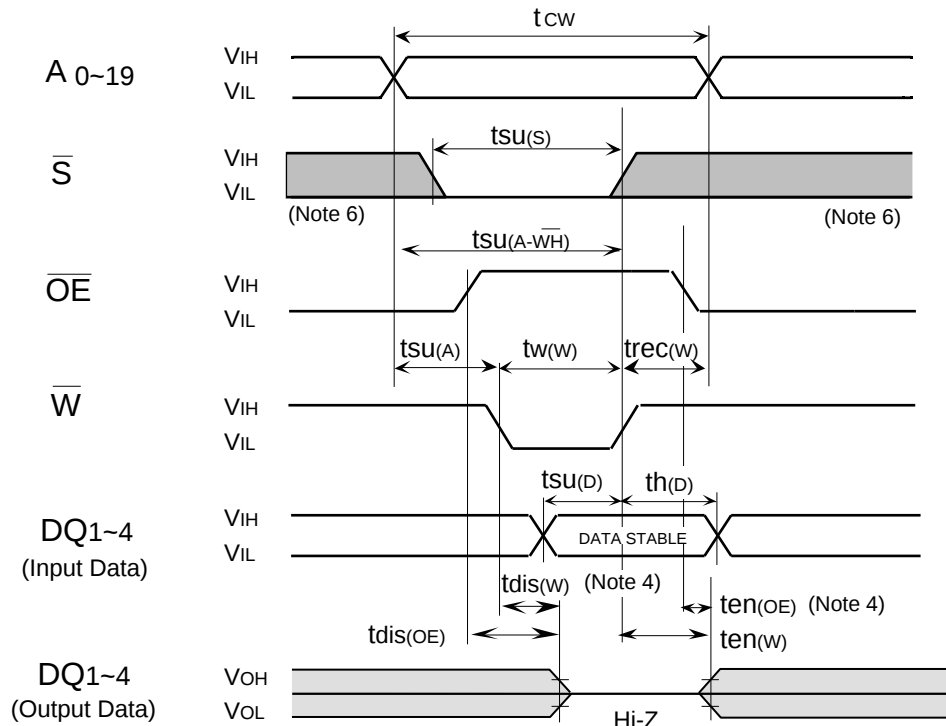
4. Transition is measured $\pm 500\text{mV}$ from steady state voltage with specified loading in Figure 2.

Read cycle 3 (Note 5)

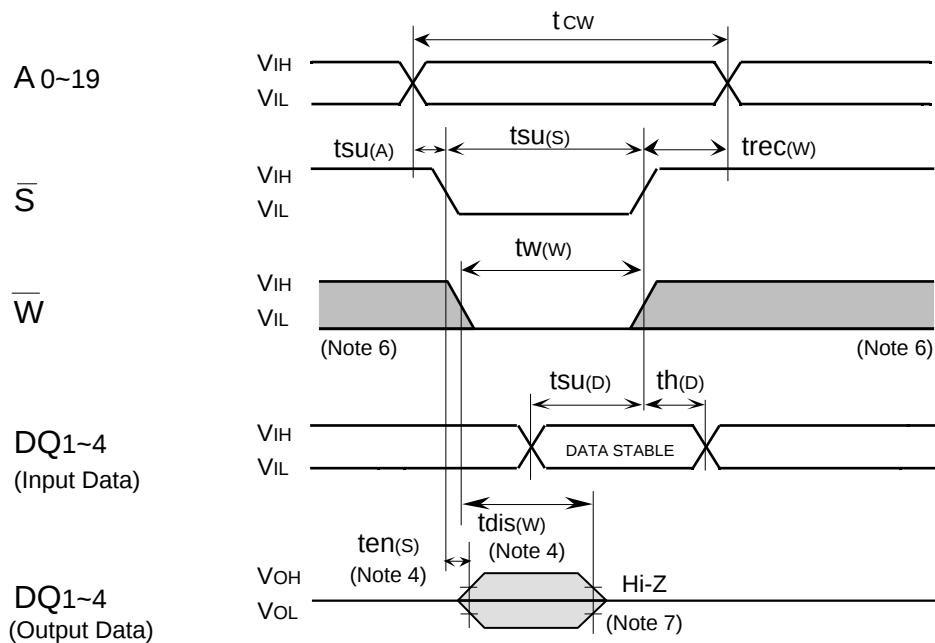


Note 5. Addresses and $\overline{S}$ valid prior to $\overline{OE}$ transition low by $(t_{a(A)} - t_{a(OE)})$, $(t_{a(S)} - t_{a(OE)})$

Write cycle ($\overline{W}$ control mode)



Write cycle ($\overline{S}$ control)



Note 6: Hatching indicates the state is don't care.

7: When the falling edge of $\overline{W}$ is simultaneous or prior to the falling edge of $\overline{S}$, the output is maintained in the high impedance.

8: t_{en} , t_{dis} are periodically sampled and are not 100% tested.